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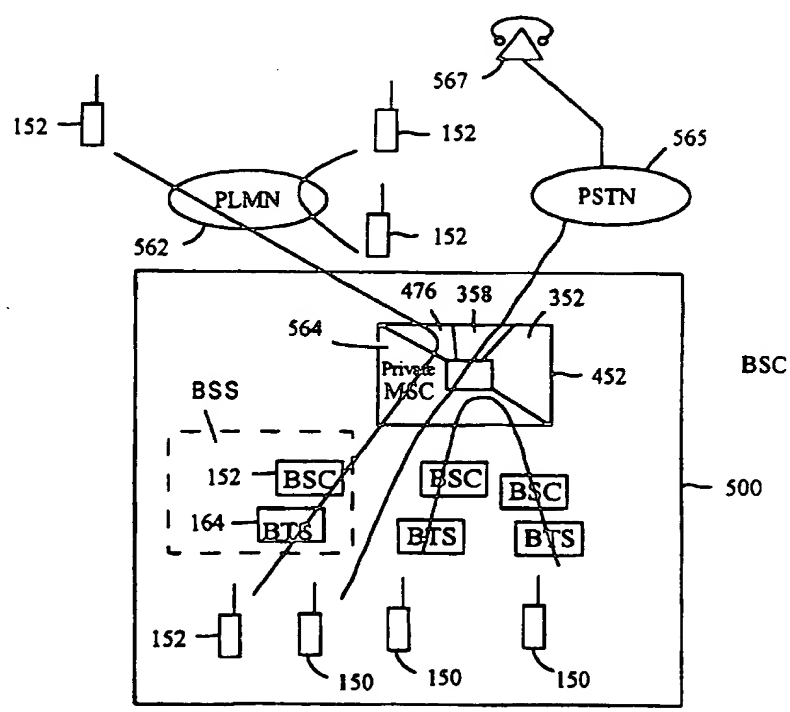
(54) Title: HYBRID CELLULAR COMMUNICATION APPARATUS AND METHOD

(57) Abstract

a method for facilitating cellular communication for and among a plurality of native cellular handsets in a hybrid cellular communication network that has a cellular exchange subsystem and a private mobile-services switching center. In this embodiment, the cellular exchange subsystem is coupled to a public cellular network, and the native cellular handsets represent handsets that subscribe to the hybrid cellular communication network. The hybrid cellular communication network further facilitates cellular communication between a non-native cellular handset and the public cellular network, with the non-native cellular handset and the public cellular network, with the non-native cellular handset being a cellular handset that does not subscribe to the hybrid cellular communication network. In this embodiment, the method includes the steps of receiving access request data, using a cellular exchange subsystem, and ascertaining whether the access request data originates from one of the plurality of native cellular handsets or from the non-native cellular handset. If the access request data originates from the one of the plurality of native cellular handsets, the method then passes data relating to the access request to the private mobile-services switching center for completing a first call path from the one of the plurality of native cellular handsets. On the other hand, if the access request data originates from the non-native cellular handset, the method passes data relating to the access request data to the public cellular network for completing a second call path between the non-native cellular handset and the public cellular network.



HYBRID CELLULAR COMMUNICATION APPARATUS AND METHOD

BACKGROUND OF THE INVENTION

The following co-pending P.C.T. and U.S. patent applications are incorporated herein by reference for all purposes:

"Cellular Private Branch Exchange," (Attorney's Docket No. WAVEP001.P) an international patent application filed under the PCT in the U.S. Receiving Office on May 3, 1996 (hereinafter WAVEP001.P).

"Methods and Apparatuses for an Intelligent Switch," (Attorney's Docket No. WAVEP004.P) an international patent application filed under the PCT in the U.S. Receiving Office on May 3, 1996 (hereinafter WAVEP004.P).

"Configuration-Independent Methods And Apparatus For Software Communication In A Cellular Network," an international patent application filed under the PCT in the U.S. Receiving Office on May 3, 1996, Attorney's Docket No. WAVEP005+.P (hereinafter "WAVEP005+.P").

"Spread Spectrum Communication Network Signal Processor," filed as a U.S. patent application in the U.S. PTO on May 4, 1995, S/N 08/434,554, Attorney's Docket No: A-60910 (hereinafter U.S. S/N 08/434,554).

"Cellular Base Station With Intelligent Call Routing," filed as a U.S. patent application in the U.S. PTO on May 4, 1995, S/N 08/434,598, Attorney's Docket No: A-61115 (hereinafter U.S. S/N 08/434,598).

"Spread Spectrum Communication Network With Adaptive Frequency Agility," filed as a U.S. patent application in the U.S. PTO on May 4, 1995, S/N 08/434,597, Attorney's Docket No: A-60820 (hereinafter U.S. S/N 08/434,597).

For ease of reference, a glossary of terms and abbreviations is provided herewith as Appendix A.

The present invention relates generally to cellular communications networks. More particularly, a private cellular exchange network that has the ability to optionally act as a base station subsystem in an even larger network to permit nonnative handsets to use the local network's resources is described.

Presently, there are a variety of wired and wireless private branch exchanges (PBX's) that are commercially available. By way of example, Fig. 1 diagrammatically illustrates a

When calls are always switched at the highest level of the hierarchy, call paths to and from the cordless handsets are oftentimes unnecessarily back hauled all the way to the highest level, i.e., the wPBX, although it may be more efficient to cross connect closer to the cordless handsets, i.e. at a base unit at a lower level of the hierarchy.

Another disadvantage of the prior art wireless PBX's relates to its inablility to authenticate calling and destination handsets to ascertain whether the handsets currently in communication with the system is in fact the intended ones. This is because any prior wireless handset that happens to be on the same frequency and utlizes the same protocol as the base unit can intercept a given call. Because of this limitation, there is no way in the prior art wPBX to define and discriminate among the particular handsets that are authorized to use the resources of the wireless system to make and receive calls from those that merely have the technical ability, but not authorized, to use those resources. For the purpose of the present disclosure, the former is regarded as native handsets and the latter nonnative ones.

It should be appreciated that in some applications, it would be desirable to provide a system which discriminates between native and nonnative handsets and permits nonnative handsets that enter an area controlled by a private exchange system to utilize the resources of that private exchange system to seamlessly connect to a public network.

SUMMARY OF THE INVENTION

To achieve the foregoing and other objects and in accordance with its purpose, the present invention relates, in one embodiment, to a hybrid cellular communication apparatus in a hybrid cellular communication network, which has a base station subsystem and a switch circuit, for facilitating cellular communication for and among a plurality of native cellular handsets. The hybrid cellular communication network also facilitates cellular communication between a nonnative cellular handset and a public cellular network, which has a public mobile-services switching center. The nonnative cellular handset represents a cellular handset that does not subscribe to the hybrid cellular communication network.

In this embodiment, the apparatus includes a cellular exchange subsystem coupled to the base station subsystem and the public cellular network. In turn, the cellular exchange subsystem includes a private mobile-services switching center coupled to the switch circuit for providing mobility management for the plurality of native cellular handsets. The switch circuit represents a node wherein a bearer data channel from any of the plurality of native cellular

If the access request data originates from the one of the plurality of native cellular handsets, the method then passes data relating to the access request to the private mobile-services switching center for completing a first call path from the one of the plurality of native cellular handsets. On the other hand, if the access request data originates from the nonnative cellular handset, the method passes data relating to the access request data to the public cellular network for completing a second call path between the nonnative cellular handset and the public cellular network.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention relates generally to local cellular exchange systems. More particularly, hybrid local cellular exchange systems are described that permit nonnative handsets to utilize the resources of the local cellular exchange system to communicate through a public (or at least non-local) network. By way of background, a detailed description of a modular local cellular exchange system is provided in co-pending application entitled: "Cellular Private Branch Exchanges" (Attorney's Docket No. WAVEP001.P), which is incorporated herein by reference. The described embodiments are extensions of the systems described therein. The distributed switching and TRAUing functions utilized in the hybrid system described herein are further described in detail in co-pending application entitled "Methods and Apparatuses for an Intelligent Switch," (Attorney's Docket No. WAVEP004.P) which is also incorporated herein by reference.

Referring initially to Figures 2-4, a hybrid network 500 that is arranged to permit nonnative handsets to utilize the resources of a local cellular exchange system to communicate to a public network in accordance with one embodiment of the present invention will be described. The described embodiment is set up for operation in compliance with the Global Systems for Mobile Communication (GSM) protocol that will be familiar to those skilled in the art. However, it should be appreciated that other communication protocols can be used as well. Since many of the components described herein accomplish GSM functions, familiar terms such as mobile-services switching center (MSC), base station controller (BSC), base transceiver station (BTS), Home Location Register (HLR) and Transcoder-Rate Adapter Unit (TRAU) will be used herein. However, as will be apparent from the described embodiments and the incorporated references, many of the described components may be embodied as modular components that have significant advantages over components of conventional systems.

In the embodiment shown in Fig. 2, the hybrid local cellular exchange system 500 includes a cPBX subsystem 452 that performs many of the switching functions of a GSM mobile-services switching center (MSC). The cPBX controls one or more base station controllers (BSCs) 172, each of which controls one or more base transceiver station (BTSs) 164. Each base transceiver station (BTS) 164 in turn is capable of coordinating communications with a plurality of cellular handsets 150, and 152 (commonly referred to as mobile station units (MSs)) that are located within the range of the BTS's antenna subsystem 158. For the purposes of this description it becomes important to distinguish between "local" handset 150 that are "native" to local cellular exchange system, and "nonnative" handsets 152 that do not belong to the local exchange. More specifically, "native" handsets are registered with the private registry within cPBX subsystem 452, while "nonnative" handsets are not (although in some embodiments, they are substantially equivalent functionally).

The described hybrid network systems may be utilized in a wide variety of applications where it is desirable for native handsets to communicate with one another without the overhead of a public system, yet also permit nonnative handsets to use the resources of the hybrid network to access the public network. By way of example, in corporate applications, it may be desirable for a company to have an internal cellular communications system, yet still allow visitors or customers to use their own cellular phones while on-site. Similarly, it may be desirable for a shopping centers, office complex, office building or other such multiple tenant operations to provide their tenants with intra-facility communications, while also permitting customers to use the building or complex's cellular resources to connect to the public network. In remote locations, the local hybrid network may be implemented for a community, a production operation, or any of a wide variety of other organizations which have similar needs.

In some applications it may be desirable to limit the local network resources used by nonnative handsets so as to preserve a minimum level of access for native handsets. By way of example, a hybrid network 500 may be designed such that up to 20% of the radio bandwidth of the private network may be allocated to nonnative handsets while at least 80% of the radio bandwidth resources should be allocated to native MS units. Of course, the bandwidth reserved for native handsets may be widely varied to meet the needs of a particular system. The ability to govern the sharing of resources between native handsets and nonnative handsets ensures that native handsets will not be precluded access by an excessive influx of calls involving nonnative handsets in the local area. Other priority resource allocation schemes may be used as well. By way of example, nonnative handsets may be allowed to access any unused resources with the caveat that they may be "bumped" when resources they are using are subsequently required by native handsets requesting access.

Referring next to Figures 2 and 3, a suitable network structure for the hybrid cellular exchange will be briefly described. The handsets 150, 152 are arranged to communicate with a base transceiver station (BTS) 164 using an appropriate radio link (RL) protocol. By way of example in a GSM system, the radio link (RL) protocol may take the form of a LAPD-M protocol at GSM layer 2 and is defined by standard GSM 08.58. Each of handsets 150 and 152 contains hardware and software that is suitable for handling, from its end, any required functions such as the GSM functions of radio resources control (RR), mobility management (MM), call control (CC), short message service (SMS), supplemental services (SS), and the like.

The base transceiver station (BTS) 164 includes the antenna subsystem 158, a Base Control Function (BCF) 166, a plurality of transceiver units (TRXs) 160, a Transcoder-Rate Adapter Unit (TRAU) 168 and a trunk module 170. Although BTS 164 shows only two transceiver units (TRXs) 160 for illustration purposes, it should be understood that a typical BTS unit may have any number of transceiver units. Each of TRXs 160 outputs bearer data,

communicating with, as required to improve transmission quality. Furthermore, BSC unit 172 also monitors handset communication quality to prepare for power hand-overs, e.g., when one of the handsets roams among the different areas controlled by different BTS's. When a hand-over is eminent, BSC unit 172 further initiates the hand-over.

As seen in Figure 2, BSC unit 172 may have multiple downstream trunk modules 176 for communicating with multiple BTSs. BSC unit 172 further includes a processor 184 for handling the aforementioned radio resource control (RR), an optional TRAU unit 186, and an upstream trunk module 190 that facilitates communications with cPBX subsystem 452. As pointed out above, cPBX subsystem 452 may communicate with a plurality of BSC units 172 and may include a downstream trunk module 192 for each associated BSC. Again, it should be appreciated that any of the described trunk modules may be eliminated when the various components can communicate over a local bus as opposed to a wired line or the like.

Referring next primarily to Fig. 3, a cellular exchange subsystem 452 (cPBX) in accordance with one embodiment of the present invention includes a gateway to the MSC (GMSC) 322, a private MSC block 254, a PBX block 356 and a registry 324. The gateway provides interfaces that facilitates communication between the local network and the outside world. The actual interfaces provided will vary to a great extent in accordance with the needs of a particular system, although at least one interface to a public (or other large scale) cellular network (PLMN) is required for the described hybrid systems.

In addition, the GMSC 322 may also include one or more PSTN interfaces (or other wired public interfaces), and/or one or more internal network interfaces 326. The internal network interfaces may, by way of example, connect the hybrid network to another cPBX in a multi-site cPBX network. For further information regarding the multi-site cPBX configuration, reference may be made to, for example, the above-mentioned co-pending patent application WAVEP001.P. Calls utilizing the internal network interface 326 may, but typically do not, utilize the TRAU unit. By way of example, when calls are made among cPBXs of the multi-site cPBX overlay network, TRAUing is often not necessary. This is because the handsets making those calls typically transmit and receive at the same rate. As mentioned earlier, the ability of the present invention to TRAU only when necessary advantageously improves the quality of the sound or data transmitted/received and reduces the computational overhead associated with performing rate conversion.

The registry 324 is provided to keep track of handset that have a home location within the cPBX subsystem, i.e., the native handsets. Thus, the registry 324 performs the functions of both the HLR and VLR registries that are familiar to those acquainted with the GSM standard. In some embodiments, the registry 324 is at least partially coordinated with the public GSM net administration 484 since the local network may need to know certain subscriber information that is available in the public HLR, e.g., home base information, valid supplemental service for

offloaded from the public network to the private network for calls involving native cellular handsets. Advantageously, the bandwidth of the public network is improved since the bottleneck involving public MSC usage is substantially relieved.

For calls involving nonnative handsets, the public MSC is still preferably utilized to make use of the MSC functions in the public MSC. In this manner, the entire hybrid cellular communication network functions a base station subsystem to pass data between the public MSC and the nonnative cellular handsets.

As will be apparent to those skilled in the art, conventional GSM configurations typically incorporate TRAU unit in the BSS and therefore, the MSC switches only at 64 Kbit/s. In contrast, in the embodiment shown, TRAU resources are provided at a variety of levels, including at the cPBX 452. Thus, calls within the local exchange subsystem which do not need to be TRAUed are not TRAUed. As is mentioned earlier, the elimination of unnecessary TRAUing improves both the quality of the transmitted call and effectively eliminates the computational overhead associated with the TRAUing process.

When handling calls originated from nonnative handsets that are roaming within the local network, the cPBX effectively functions as a BSS from the perspective of the PLMN network. To facilitate this, the cPBX includes a listening unit 468 and hybrid BSC block 476. Hybrid BSC block 476 is basically a software block that forwards signalling data between the BSC's of the hybrid network and the public MSC. Listening block 468, preferably implemented via software, deals primarily with signalling data while BSC block 476 and TRAU block 490 deal primarily with bearer data. As is mentioned, TRAUing may be necessary when bearer data are presented to the public MSC.

In accordance with one aspect of the present invention, a nonnative cellular handset preferably utilizes listening/translation circuit 468 and hybrid BSC 476 to communicate with a public cellular network, and more specifically to the public MSC within the public celluar network. Native cellular handset preferably utilizes either public network interface 358, PLMN interface 359, or internal network interface 326 for communicating with public networks that are external to the hybrid cellular communication network. By way of example, a native cellular handset may utilize public network interface 358 to communicate with a wired public network, e.g., a PSTN. The native cellular handset may also utilize PLMN interface 359 to communicate with a public cellular network, e.g., a PLMN. Consequently, as the term is used herein, a pubic network refers to a network that is external to the hybrid cellular communication network, whether that public network is a PSTN, a PLMN, an ISDN, or others. Thus, the hybrid cellular communication network, via an appropriate interface, facilitates communication between a native cellular handset and a public network.

Configuration of the private registry may be performed by the system operator during periodic update/maintenance periods. During these update periods, the system operator may create a new record, delete a record, obtain a record for review, or edit information in a record.

In one embodiment, there also exists a column for specifying the network identifier for each cellular handset. A network identifier may be advantageous in environments where there exists a plurality of overlapping private cellular network, and there exists a need for identifying the specific private network to which a given handset belongs.

Referring next to Figures 6-11, a method of coordinating calls from both native and nonnative handsets in accordance with one embodiment of the invention will be described. It should be appreciated that the vast majority of the handling protocol will be dictated by the protocols of the public system that the hybrid network operates transparently with (i.e. PLMN 562). The reason for this is that from the standpoint of a nonnative handset 152, a call originated within the local network must look and feel the same as a call originated outside of the local network. In the described embodiment, the associated public network conforms to the GSM standard. Accordingly, the BTS to BSC and BSC to cPBX (i.e. MSC) communications in the described embodiment are in accordance with the GSM standard. As pointed out above, the cPBX subsystem 452 has the ability to monitor communication data such as access request data that relates to calls and/or location update requests originating therein. As is known, such access request data may include GSM messages such as LOCATION UPDATING REQUESTS, CM SERVICE REQUEST, CM REESTABLISHMENT REQUEST, PAGING RESPONSE, and IMSI DETACH as appropriate. CPBX subsystem 452 then determine whether each such call or location update requests originated from a native or a nonnative handset and handle the calls accordingly. When the call or location update request originates from a native handset 150, the cPBX effectively acts as described in the referenced applications WAVEP001.P, WAVEP004.P, and WAVEP005+.P. On the other hand, when it is determined that the call originated from a nonnative handset 152, the cPBX essentially acts as a conduit between the BSC 172 and the public MSC 562. Thus, the hybrid local cellular exchange system takes on the appearance of a standard BSS from the perspective of the nonnative handsets and the public network.

Referring next to Fig. 6, the handling of a channel request in accordance with one embodiment of the invention will be described. Initially, a handset (MS unit) sends out a channel request which is received by the nearest BTS in step 901. The channel request essentially asks for a channel for the handset to operate on. There is no voice path assigned at this point since it is not known whether the handset is performing a location update, call origination, or responding to a beacon message on a dedicated channel reserved for determining

may be request that the public MSC hands off this call to a neighboring public cell, which may then handle the call using standard GSM procedures.

Referring next to Fig. 7, a method suitable for accomplishing the determination of whether a call is made from a native or nonnative handset (step 910 of Fig. 6) will be described in more detail. Typically, the steps of Fig. 7 are performed by the translation/listening circuit 468 of Fig. 3. Initially, it should be appreciated that standard GSM access requests received from the handset in step 909 will each contain an International Mobile Subscriber Identification (IMSI) of the requesting handset. The IMSI is retrieved in step 1001 by the listening unit 468 within the cPBX subsystem 452 so that a determination can be made as to whether the requesting handset is a native or nonnative handset and appropriate action can be taken. The capability of looking at the IMSI and adjusting functionality accordingly, is referred to as Promiscuous Listening. The feature of Promiscuous Listening signifies an added intelligence implemented in the present invention and highlights one of the difference from conventional approaches.

In some embodiments, a location update request may contain a version of the IMSI, known as a TMSI (temporary MSI that is used in place of the IMSI for, among others, security reasons). The identity of the handset, via either the IMSI or TMSI, uniquely identifies the handset that desires a location update or access. After the IMSI (or an abbreviation thereof) has been retrieved from the access request, a process access request call is made (in block 1002) by the private MSC to the registry 324, which starts up an authentication process. The process access request call is received by the registry 324 in corresponding step 1004 and the ISMI (or an abbreviation thereof) is check against the HLR/VLR (Home and Visitor Location Registry) which contains a listing of authorized users in the private network in step 1006. If the IMSI is found in the registry, then it is presumed that the originating handset is a native handset and the subscriber is authenticated in a conventional manner in step 1010. In some embodiments, the authentication may require the handset to provide an encrypted key to help prevent user fraud.

In block 1010, if the IMSI is not found in the HLR, it is, in one embodiment, denied access to the private network immediately so that it can be passed to the public MSC (in step 1008 of Fig. 7 and step 915 of Fig. 6) for authentication. If the IMSI is found but fails private HLR authentication then access to the private network is also denied. However, this IMSI is not subsequently passed to the public MSC (in blocks 914 and 915 of Fig. 6) since the call associated with this access request is presumably a fraud. In accordance with the GSM protocols, a determination of whether the subscriber was authenticated is then made in step 1012. Assuming the subscriber is authenticated, a private network access granted signal is returned to the private MSC in step 1014.

The MSC subsequently sends a Call Proceeding message substantially transparently through cPBX subsystem 452 to the handset in step 923, which indicates that the public MSC will process the call. As will be appreciated by those skilled in the art, the previously described interactions will take place on a signaling channel. It is now necessary to assigned an actual bearer channel. This is initiated by an assignment request for a traffic channel that is received by the private MSC/BSC in block 925, which proceeds to assign a second traffic channel within the private hybrid network 500 between cPBX subsystem 452 and BSC 172 in step 926. The traffic channel is selected from the free channels that are available on the link between cPBX subsystem 452 and BSC 172.

Continuing to step 927, a channel activate message is sent from the BSC to the BTS which essentially asks the BTS to activate the selected channel. The BTS activates the requested channel and confirms the activation to the BSC via a Channel Activate Acknowledgment signal as shown in step 931. Thereafter, in step 933, the BSS sends the handset an Assignment Command that designates a traffic (voice/data) channel for the current communication thereby reassigning the handset to the newly assigned traffic channel. The handset then sends an Assignment Complete message to the BSS on the new channel, as shown in step 937. Thereafter, the assigned bearer channel is coupled to the assigned traffic channel in step 938. Then in step 939, an Assignment Complete Acknowledge is sent from the BSC to the public MSC over an overhead signaling channel. The message sent may be, as noted above, modified by Translation/Listenting unit 468 of Figs. 2 and 3 to ensure proper communication between the nonnative MS unit and the public MSC. Thereafter, the call is in progress and the communications between the nonnative handset and the public MSC are simply passes back and forth by the BSC.

At some point the call will be ended. A procedure suitable for use in disconnecting a call from the standpoint of the BSC in accordance with one embodiment of the present invention will be described with reference to Fig. 9. The disconnection will begin with the generation of a Disconnect Release message from one of the public MSC and the handset depending on whether the caller or called party hangs up (such as pushing the end button, hanging up a conventional phone, etc.). The Disconnect Release message is passed between the handset and MSC, as shown in step 1151. A Release Complete message will then be generated by the receiving component and the release complete message will be acknowledged. The handset ends the three way handshake procedure by sending a Release Complete which is subsequently acknowledged in step 1153.

At this point the MM session and radio resources are still assigned by the BSC and a SCCP clear command is issued by the public MSC to the BSC to clear all resources associated

although authorized to use the private network resources, may be blocked from attempting to make calls to certain external areas, e.g., overseas or long distance.

The registry returns to the MSC its findings in the map complete message in block 810. The map complete message sent in step 810 is received by the private MSC from the registry in step 812. In step 806, it is ascertained whether the calling handset is authorized to make the call attempted. If not, the method proceeds to step 808 to reject the attempt and to clear the MM session. The call attempted is also rejected, in step 808, if the caller attempts to use a supplemental service (SS) that the calling handset has not subscribed to or is unavailable to the private cPBX network. After it is determined in step 806 that the call should be rejected, an SCCP clear message is preferably sent from the MSC to BSC to clear the MM session all the way to the handset. After the MM session is cleared, the BSC sends a clear complete message from the BSC to the MSC.

If the MS unit was authorized to place the call, the private MSC 254 sends the cPBX 452, in step 814, an initial address message (IAM) which, in the GSM implementation, includes the destination phone number to indicate its desire to connect to a particular destination phone. If intelligent switching is involved, it is the cPBX that decides the optimal cross-connect point, e.g., via BTS, BSC, cPBX or forwards the call to a public network, or another cPBX.

In step 816 the private MSC 254 sends to the handset a call proceeding message responsive to a validation of the destination phone to indicate that the call is being processed. In step 818, private MSC 254 receives an address complete message (ACM) from the cPBX 452 which indicates that the entire destination number (the dialed number) has been received and that the call has been connected to its destination. The receipt of the ACM message by the private MSC also signifies a successful alerting on the called party, i.e., the destination phone is ringing. In step 820, the private MSC sends to the handset, responsive to the receipt of the ACM message received in step 818, an alerting message to the handset to inform the handset that the party called is being alerted and to turn on the ringer at the calling handset.

In step 822 the private MSC sends the BSC an assignment request message to assign channel for the bearer, e.g., the actual voice/data, channel on the A interface and to instruct the BSC to use the assigned channel to build the call. The assigned channel represents the channel on which the calling handset may send and receive its bearer data. It should be noted that the steps in step 822 may occur asynchronously with respect to the other steps of Fig. 11. In one embodiment, the private MSC sends the assignment request to the BSC right after the private MSC sends to the cPBX the IAM message (step 814). After the alerting message is received by the handset, the ringer circuit at the calling handset continues to ring until either the called party picks up the call or the caller hangs up, in which case the MM session is again cleared in the manner earlier discussed.

RF:	module Radio Frequency module
RL:	Radio Link
RR :	Radio Resource Management
SCCP:	Signalling Connection Control Part
SFB:	Software Functional Block
SMS :	Short Message Services
SS:	Supplemental Services
TDM data:	Time Division Multiplexed Data
TRAU:	Transcoder-Rate Adapter Unit
TRX:	Transceiver
VLR:	Visitor Location Registry
VME:	An industry standard bus for interconnecting components
wPBX:	wired PBX

European Telecommunications Standards Institute, "European digital cellular telecommunications system (Phase 2); Mobile Application Part (MAP) specification (GSM 09.02)", 1994, Valbonne - France.

European Telecommunications Standards Institute, "European digital cellular telecommunications system (Phase 2); Signaling requirements on internetworking between the Integrated Services Digital Network (ISDN) or Public Switched Telephone Network (PSTN) and the Public Land Mobile Network (PLMN) (GSM 09.03)", 1994, Valbonne - France.

network if said circuit determines that said communication data originates from said nonnative cellular handset, wherein said hybrid base station controller functions to forward and translate communication data between said public cellular network and said base station subsystem within said hybrid cellular communication network.

2. The hybrid cellular communication network of claim 1 wherein said nonnative cellular handset is a cellular handset implementing the GSM protocol.

3. The hybrid cellular communication network of claim 2 wherein each of said plurality of native cellular handsets implements said GSM protocol.

4. The hybrid cellular communication network of claim 1 wherein calls between any two of said plurality of native cellular handsets are TRAUed only if they communicate at different rates.

5. The hybrid cellular communication network of claim 1 further comprising a base station controller coupled to said mobile switching center, said base station controller representing a node for cross-connecting calls between any two of said plurality of native cellular handsets that are both currently within a domain of said base station controller.

6. The hybrid cellular communication network of claim 5 further comprising a base transmitter station coupled to said base station controller, said base transmitter station representing a node for cross-connecting calls between any two of said plurality of native cellular handsets that are both currently within a domain of said base transmitter station.

7. The hybrid cellular communication network of claim 2 wherein said circuit passes said communication data from said nonnative cellular handset to said public cellular network for completing said call path only if a completion of said call path does not result in exceeding resources of said hybrid cellular communication network allocated to nonnative cellular handset usage.

that both subsribe to said hybrid cellular communication network may be completed without using resources of said public cellular network irrespective of which cellular communication subsystem said first native cellular handset and said second native cellular handset are in communication with.

13. The hybrid cellular communication network of claim 2 wherein said communication data is an access request.

14. In a hybrid cellular communication network having a cellular exchange subsystem and a private mobile-services switching center, said cellular exchange subsystem being coupled to a public cellular network, a method for facilitating cellular communication for and among a plurality of native cellular handsets, said native cellular handsets being handsets that subscribe to said hybrid cellular communication network, said hybrid cellular communication network further facilitates cellular communication between a nonnative cellular handset and said public cellular network, said nonnative cellular handset being a cellular handset that does not subscribe to said hybrid cellular communication network, when said nonnative cellular handset is within a domain of said hybrid cellular communication network, comprising:

receiving access request data, using a cellular exchange subsystem;

ascertaining whether said access request data originates from one of said plurality of native cellular handsets or from said nonnative cellular handset;

if said access request data originates from said one of said plurality of native cellular handsets, passing data relating to said access request to said private mobile-services switching center for completing a first call path from said one of said plurality of native cellular handsets; and

if said access request data originates from said nonnative cellular handset, passing data relating to said access request data to said public cellular network for completing a second call path between said nonnative cellular handset and said public cellular network.

15. The method of claim 14 further comprising the steps of:

if said access request data originates from said one of said plurality of native cellular handsets, receiving a destination phone number from said one of said plurality of native cellular handsets;

communication network, when said nonnative cellular handset is within a domain of said hybrid cellular communication network, comprising:

means for receiving access request data, using a cellular exchange subsystem;

means, coupled to said receiving means, for ascertaining whether said access request data originates from one of said plurality of native cellular handsets or from said nonnative cellular handset;

means, responsive to said ascertaining means, for passing data relating to said access request to said private mobile-services switching center for completing a first call path from said one of said plurality of native cellular handsets if said access request data originates from said one of said plurality of native cellular handset; and

means, responsive to said ascertaining means, for passing data relating to said access request data to said public cellular network for completing a second call path between said nonnative cellular handset and said public cellular network if said access request data originates from said nonnative cellular handset.

20. The apparatus of claim 19 further comprising the steps of:

means for receiving a destination phone number from said one of said plurality of native cellular handsets if said access request data originates from said one of said plurality of native cellular handsets;

means for completing said first call path between said one of said plurality of native cellular handsets and said another one of said plurality of native cellular handsets without using resources of said public cellular network if said destination phone number is associated with another one of said plurality of native cellular handsets; and

means for completing said first call path between said one of said plurality of native cellular handsets and a public network if said destination phone number is not associated with a cellular handset that subscribes to said hybrid cellular communication network.

21. The method of claim 19 wherein said ascertaining means further comprises:

means for extracting a handset identifier from said access request data; and

means for comparing said handset identifier against records in a registry associated with said cellular exchange subsystem.

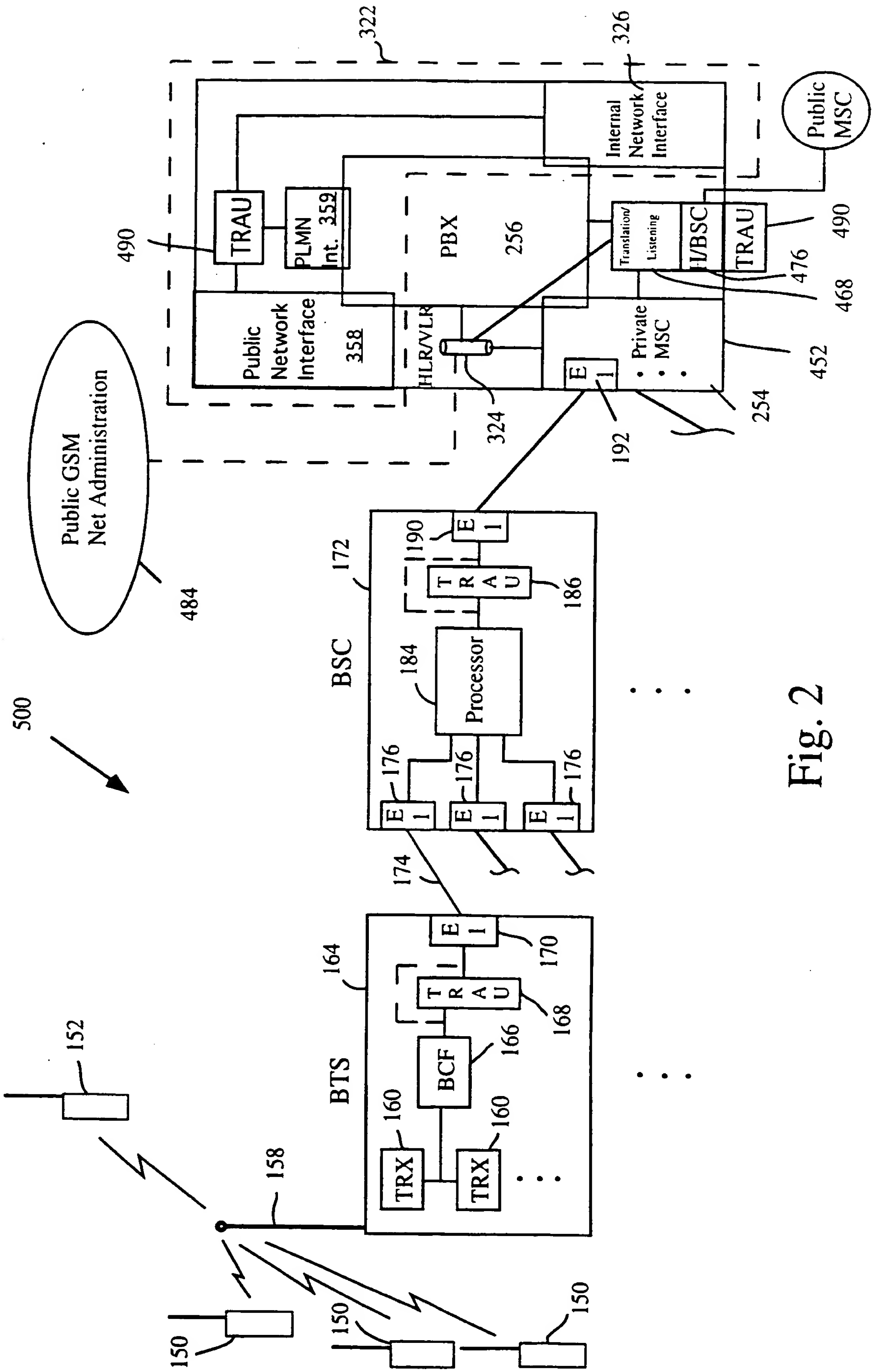

322
326
Internal
Network
Interface
Public
MSC
TRAU
PLMN
Int. 359
PBX
256
Translation/
Listening
I/BSC
TRAU
490
476
468
490
Public
Network
Interface
358
HLR/VLR
E
1
Private
MSC
452
254
324
192
Public GSM
Net Administration
484
BSC
172
190
E
1
T
R
A
U
186
184
Processor
176
176
176
E
1
E
1
E
1
500
174
164
E
1
170
T
R
A
U
168
BTS
BCF
166
152
160
160
TRX
TRX
158
150
150
150

Fig. 2

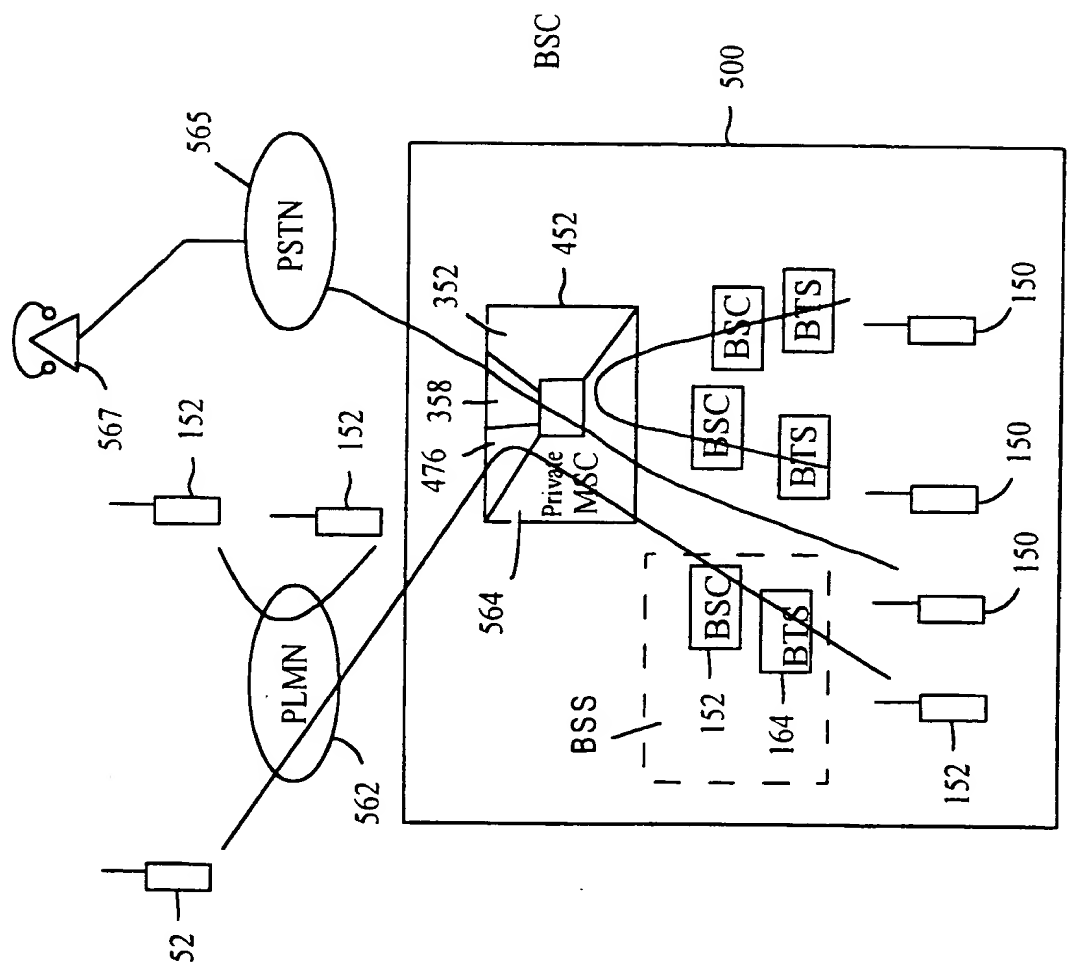

BSC
500
565
PSTN
452
352
358
476
Private MSC
BSC
BTS
BSC
BTS
150
150
150
567
152
152
564
BSC
BTS
PLMN
BSS
152
164
152
562
152

Fig. 4

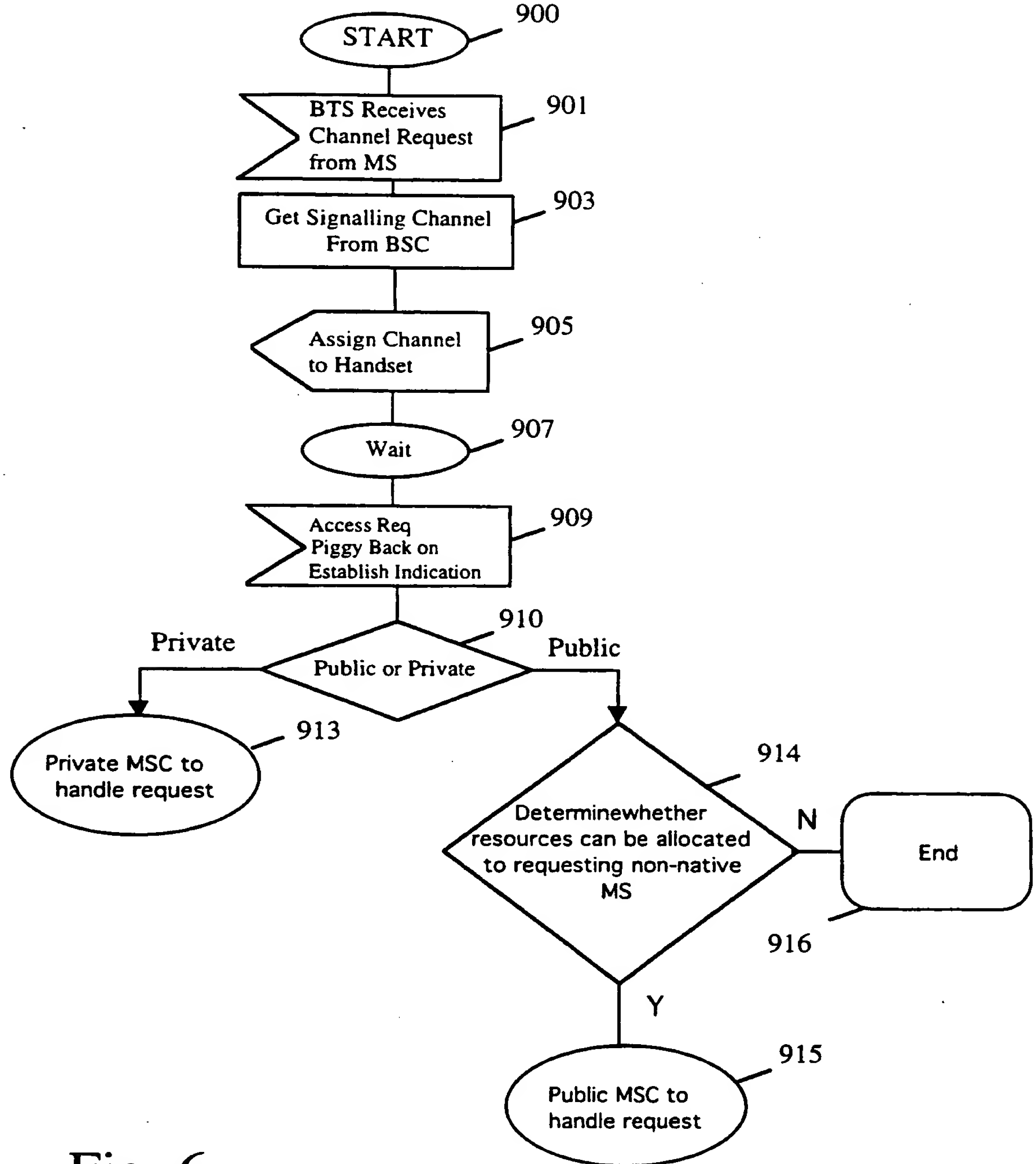
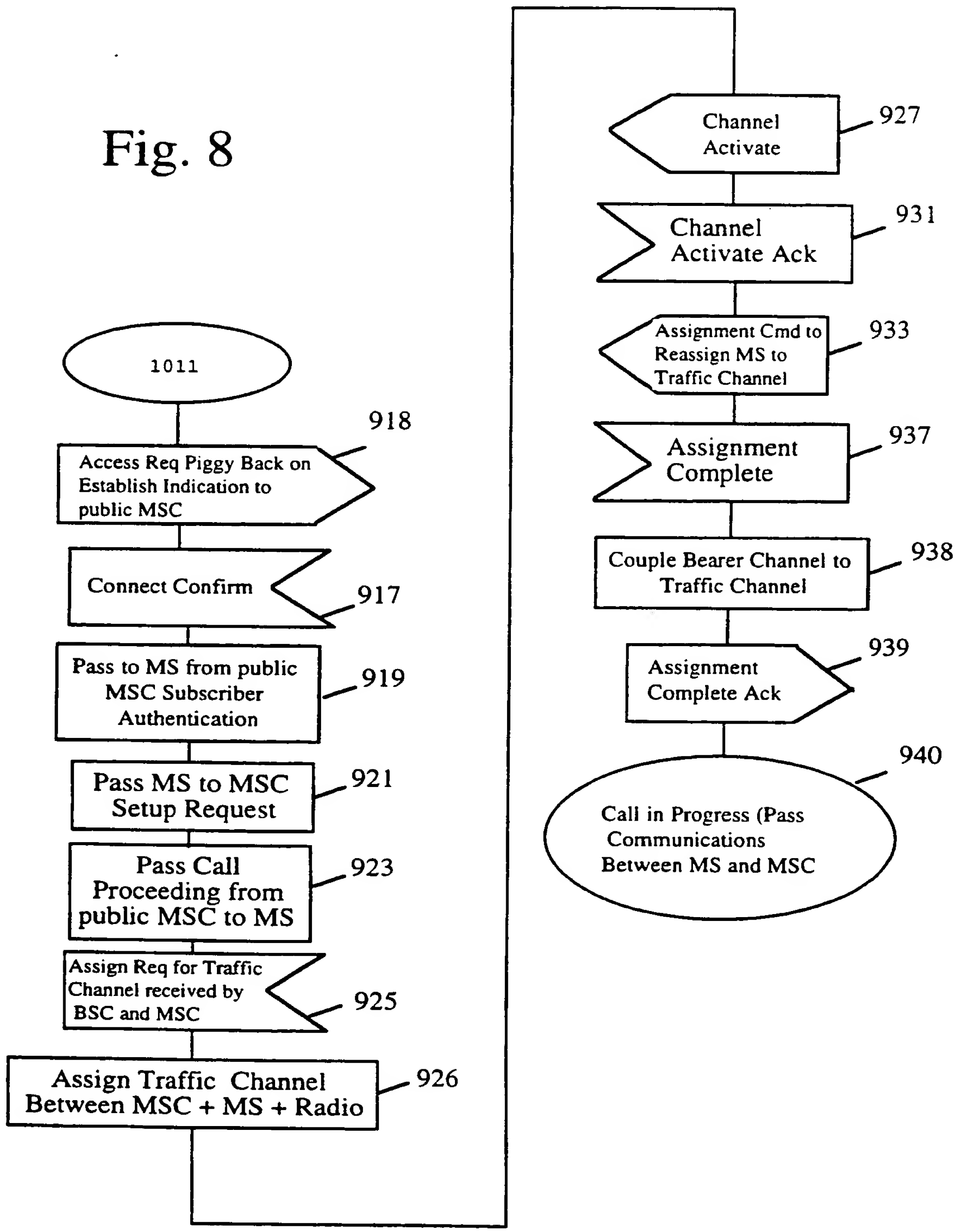

START
900
BTS Receives Channel Request from MS
901
Get Signalling Channel From BSC
903
Assign Channel to Handset
905
Wait
907
Access Req Piggy Back on Establish Indication
909
Public or Private
910
Private
Public
Private MSC to handle request
913
Determinewhether resources can be allocated to requesting non-native MS
914
N
End
916
Y
Public MSC to handle request
915

Fig. 6

Fig. 8


1011
Access Req Piggy Back on Establish Indication to public MSC
918
Connect Confirm
917
Pass to MS from public MSC Subscriber Authentication
919
Pass MS to MSC Setup Request
921
Pass Call Proceeding from public MSC to MS
923
Assign Req for Traffic Channel received by BSC and MSC
925
Assign Traffic Channel Between MSC + MS + Radio
926
Channel Activate
927
Channel Activate Ack
931
Assignment Cmd to Reassign MS to Traffic Channel
933
Assignment Complete
937
Couple Bearer Channel to Traffic Channel
938
Assignment Complete Ack
939
Call in Progress (Pass Communications Between MS and MSC
940

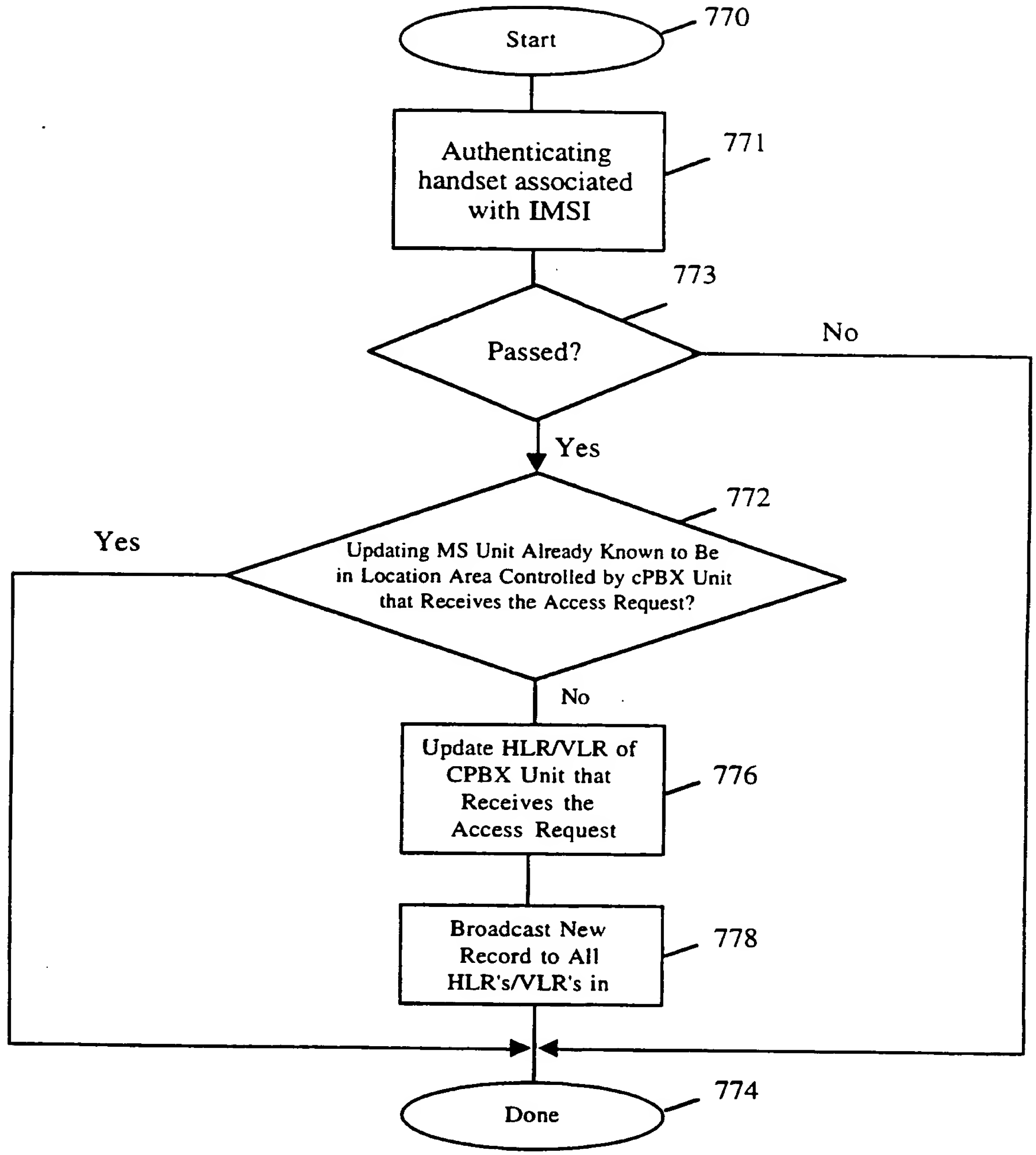

Start
770
Authenticating handset associated with IMSI
771
773
Passed?
No
Yes
772
Yes
Updating MS Unit Already Known to Be in Location Area Controlled by cPBX Unit that Receives the Access Request?
No
Update HLR/VLR of CPBX Unit that Receives the Access Request
776
Broadcast New Record to All HLR's/VLR's in
778
Done
774

Fig. 10

INTERNATIONAL SEARCH REPORT

Interr ·onal Application No
PC⊦/US 96/06290

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04Q7/38 H04Q7/26 H04Q7/24

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 94 26073 A (ERICSSON TELEFON AB L M) 10 November 1994 see page 2, line 14 - page 3, line 7 see page 3, line 23 - page 6, line 7 see page 6, line 22 - page 8, line 3 see page 9, line 8 - page 10, line 18 ---	1,14,19
A	EP 0 462 728 A (NORTHERN TELECOM LTD) 27 December 1991 see column 3, line 15 - column 4, line 3 see column 8, line 28 - line 55 see column 9, line 38 - line 57 --- -/--	1,14,19

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

1

Date of the actual completion of the international search	Date of mailing of the international search report
9 September 1996	20.09.96

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Gerling, J.C.J.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/US 96/06290

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
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		CN-A-	1108463	13-09-95
		EP-A-	0653140	17-05-95
		FI-A-	946141	28-12-94
		JP-T-	7508634	21-09-95
		NO-A-	944961	21-12-94
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		CA-A-	2044435	19-12-91
		NO-B-	179388	17-06-96
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		AU-B-	4960693	15-03-94
		CA-A-	2143319	03-03-94
		EP-A-	0671110	13-09-95
		HU-A-	71653	29-01-96
		JP-T-	8502391	12-03-96
		NO-A-	950715	31-03-95
		PL-A-	307680	12-06-95
		AU-B-	7462594	21-03-95
		EP-A-	0715792	12-06-96
		FI-A-	942842	16-12-95
		WO-A-	9506381	02-03-95
		HU-A-	73132	28-06-96
		NO-A-	960727	23-02-96